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# PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: ROGER VICTOR GAMON

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## COMPLETE SPECIFICATION

### Liquid Detector

We, BURNDIPT LIMITED, a British Company of Canada Road, Oyster Lane, Byfleet, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a liquid detector arranged to give an electrical signal only while liquid is present within a pipe and to indicate the absence of liquid, as upon the reduction or cessation of liquid flow through the pipe by the interruption of such signal. This interruption of electrical signal may serve to close a valve in the pipe and, if required, energize an alarm.

Circumstances often arise in which it is important that pumping action should cease when a pipe is not filled with liquid. A particular instance arises when a tank vehicle is being used to draw off water from a sump in a town gas main. The vehicles used for this purpose have tanks in which a vacuum is created. A pipe is inserted into the sump in the gas main and a valve opened so that the water is drawn into the evacuated tank. Upon the water becoming completely removed unless the valve is closed, gas will be drawn in large quantities into the evacuated storage tank causing a momentary fall in pressure which may result in gas pilot lights being extinguished with the possibility of very serious consequences. A liquid detector in accordance with the invention can be used to close the valve of a tank vehicle and energize an alarm.

In a liquid detector in accordance with the invention the presence or absence of liquid in a pipe is detected by a proximity switch, for example a switch of the type having a probe of which the electrical capacity varies with the proximity or otherwise of the liquid to be detected. In accordance with the invention the probe of an electronic proximity switch is mounted around a length of transpar-

ent tubing of insulating material adapted to form part of the pipe which may, for example constitute a section of a liquid flow pipe. The switch is arranged so that its output will be interrupted so as to give an electrical indication whenever the flow of liquid in the transparent tubing is reduced or ceases. The proximity switch may be arranged so that its operation can be cancelled until such time as observation of the transparent tube shows that the section of the pipe is filled with liquid.

A suitable proximity switch is the transistor operated device described in our co-pending application number 32705/62 Serial No. 1,054,248) arranged to fail to safe in the appropriate manner to ensure that a false signal never indicates the presence of liquid when there is none.

Thus the switch preferably comprises an oscillator circuit with two resonant elements, one of which is an inductance/capacitance resonant element and includes the said probe as part of its capacity, and the other of which is a piezo electric crystal so arranged as to oscillate, and thus cause the detector to give an output signal, only when the capacity of the probe is such as to indicate the presence of liquid in the tube.

In order that the invention may be more thoroughly understood a liquid detector in accordance with it, mounted on a tank vehicle for withdrawing water from town gas mains, will be described in some detail by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a diagram of the layout of the detector;

Figure 2 shows the box in which the detector is housed, with parts broken away; and

Figure 3 is a circuit diagram of the proximity switch.

In the arrangement shown in the drawings a proximity switch 10 of the kind described in our co-pending application 32705/62

(Serial No. 1,054,248) is modified to act as a liquid detector and it is mounted on a vehicle (not shown) and so adjusted that when water withdrawn from a gas main sump to an evacuated tank 12 is flowing through the suction pipe 14 there is no electrical indication, but upon reduction of the water flow or cessation of that flow, a relay 16 operates and energizes an alarm system, whereupon a valve 18 in the suction pipe is closed, thus preventing the highly undesirable withdrawal of gas after the sump has been emptied of water.

The liquid detector 10 is enclosed in a box 20 (Figure 2) which is divided into two compartments. Through the lower compartment 22 there passes a length of transparent tubing 24 of electrically insulating material which constitutes a section of the main suction pipe 14 feeding the evacuated tank 12 on the vehicle. Around this transparent tubing is fitted a cylindrical metal probe 26 which is connected to the proximity switch.

The proximity switch incorporates a push-button switch 28 by which the operation of the unit 10 can be cancelled out until such time as the section 14 of the pipe 14 is filled with water, as shown to the operator by observation of the transparent tube. If this push-button switch were not provided the vehicle could never operate because the valve would always be closed, the proximity switch sensing the condition where there is no liquid flow.

All the electrical parts of the switch 10 apart from the probe 26 are housed in the upper part 23 of the box 20. The circuit is shown in Figure 3. It is generally similar to the switch described in the co-pending application mentioned above and operates on the same principle. While there is liquid in the pipe section 24 the probe 26 presents a capacity which, in conjunction with the effective capacity of the network 30 ensures that the LC resonant element comprising the probe 26, and the networks 30 and 32 in the collector circuit of the transistor 34 is capacitive. The quartz crystal 36 being located between the collector and the base of the transistor this condition results in oscillation.

The transistor 34 is transformer coupled to the rectifier 38 and so long as oscillation is maintained the rectified output causes forward bias to be applied to the base of the first, PNP, transistor 40 of a PNP — NPN pair so that the second transistor 41 of the pair conducts and its collector current energises the coil 16A of the relay 16.

Thus so long as there is liquid in the pipe section 24 the relay 16 will be energised and the contacts 16B closed to cause the valve

18 to be held open. The second set of contacts 16C of the relay are at the same time switched to illuminate the lamp 42.

If there is no liquid in the section 24 or in the event of any failure either of power supply or of the circuit, oscillation will cease and the relay 16 will be de-energised thus opening the contacts 16B and allowing the valve 18 to close. The relay contacts 16C will be switched to illuminate a warning light 44.

The signal resulting from failure is thus, as required, the same as that which indicates the absence of liquid in the pipe section 24 and the system fails to safety.

The push button switch 28 is connected across the relay contacts 16B and can thus serve to open the valve 18 even when, there being no liquid in the pipe section 24, the contacts 16B are open.

#### WHAT WE CLAIM IS:—

1. A liquid detector arranged to give an electrical signal only while liquid is present within a pipe and to indicate the absence of liquid by the interruption of such signal, comprising an electronic proximity switch, the probe of which is mounted around a length of transparent tubing of insulating material adapted to form part of the pipe.

2. A liquid detector according to claim 1, in which the proximity switch comprises an oscillator circuit with two resonant elements, one of which is an inductance/capacitance resonant element and includes the said probe as part of its capacity, and the other of which is a piezo-electric crystal so arranged as to oscillate, and thus cause the detector to give an output signal, only when the capacity of the probe is such as to indicate the presence of liquid in the tube.

3. A detector according to claim 2, in which the rectified output of the oscillator is applied to a D.C. amplifier to energise a relay and maintain closed a pair of contacts.

4. A detector according to claim 3, in which the relay is arranged to hold open a valve in the said pipe so long as the said contacts remain closed.

5. A liquid detector substantially as described with reference to Figures 1 and 2 of the accompanying drawing.

6. A liquid detector according to any preceding claim, in which the switch circuit is substantially as described with reference to Figure 3 of the accompanying drawings.

SEFTON-JONES, O'DELL &  
STEPHENS,

Chartered Patent Agents,  
15, Great James Street,  
London W.C.1.

Agents for the Applicants.

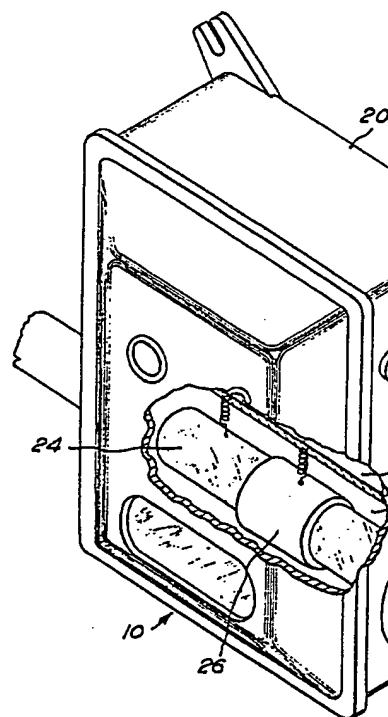


Fig. 2.

